EXAMPLE 7

[0152] A tunnel magnetoresistance effect device **50** of spin valve type was manufactured, as same as Example 6 without using a buffer layer **44**. $Co_2Fe_{0.4}Cr_{0.6}Al$ magnetic thin film of this case had B2 structure. The magnetoresistance was measured at room temperature after the external magnetic field was applied to said tunnel magnetoresistance effect device **55**.

[0153] **FIG. 24** is a view illustrating the magnetic field dependency of the magnetoresistance of a tunnel magnetoresistance effect device **50**. The abscissa of the figure is the external magnetic field H (Oe), the left-side ordinate is resistance (Ω), and the right-side ordinate is TMR (%) calculated from the observed resistance. Solid lines and dotted lines show the resistance values for the swept external magnetic field. From this, TMR of about 11% at room temperature, and of 32% at 77K were attained. $Co_2Fe_{0.4}Cr_{0.6}Al$ magnetic thin film **43** of this case had B2 structure, and from the fact that, though a buffer layer **44** was not used, such relatively large TMR was attained at room temperature, it is seen that $Co_2Fe_{0.4}Cr_{0.6}Al$ magnetic thin film of B2 structure, too, had high spin polarizability.

EXAMPLE 8

[0154] A tunnel magnetoresistance effect device **50** of spin valve type was fabricated, as same as Example 6, using Co_2FeAl magnetic thin film **43** and without using a buffer layer **44**. Co_2FeAl magnetic thin film **43** of this case had A2 structure. The external magnetic field was applied to the tunnel magnetoresistance effect device **50**, and magnetoresistance was measured at room temperature and as low temperature as 5K. As the result, TMR of 8% at room temperature and 42% at low temperature was attained. This implies that Co_2FeAl magnetic thin film of A2 structure, too, has large spin polarizability.

EXAMPLE 9

[0155] A tunnel magnetoresistance effect device **50** of magnetic coercive force difference type Co_2FeAl (10 nm)/AlO_x (1.4 nm)/CoFe (3 nm)/Ta (10 nm) was fabricated onto a thermally oxidized Si substrate at room temperature without using a buffer layer **44**. Here, the numerals in parentheses indicate respective film thicknesses. Said tunnel magnetoresistance effect device of magnetic coercive force difference type means the tunnel magnetoresistance effect device utilizing the difference of magnetic coercive force between Co_2FeAl and CoFe as ferromagnets. In TMR of said tunnel magnetoresistance effect device **50** of magnetic coercive force difference type, like a tunnel magnetoresistance effect device of spin valve type, the difference in magnetoresistance appears depending upon whether magnetization is parallel or antiparallel to each other.

[0156] The value of TMR obtained by the fabricated tunnel magnetoresistance effect device of magnetic coercive force difference type was 8% at room temperature, and 42% at low temperature of 5K. Here, the crystal structure of Co_2FeAl thin film **43** formed on the thermally oxidized Si substrate without heating the substrate was A2 structure.

[0157] Next, said magnetoresistance effect device was heat treated in vacuum at various temperatures, and respective TMR properties were measured. As a result, TMR of 1 hour heat treatment at 300° C. was 28% at room temperature, and 55% at low temperature of 5K which was remarkably higher than TMR of room temperature fabricated device. The crystal structure of Co_2FeAl thin film of this case was observed by X-ray diffraction, and turned out to have $L2_1$ structure. Therefore, the improvement of TMR by said heat treatment was due to the crystal structure of Co_2FeAl thin film changed from A2 to $L2_1$ structure, and it implies that the spin polarizability of $L2_1$ structure is larger than that of A2 structure.

EXAMPLE 10

[0158] A tunnel magnetoresistance effect device **50** of the spin valve type was fabricated as same as Example 5, except for using GaAs as a substrate **44**. $Co_2Fe_{0.4}Cr_{0.6}Al$ magnetic thin film **43** of this case had $L2_1$ structure. The external magnetic field was applied to to said tunnel magnetoresistance effect device **50**, and the magnetoresistance was measured at room temperature. As a result, TMR as large as 125% was attained at room temperature, which implies the spin polarizability of $Co_2Fe_{0.4}Cr_{0.6}Al$ magnetic thin film of $L2_1$ structure is quite large.

EXAMPLE 11

[0159] A giant magnetoresistance effect device **75** of spin valve type shown in **FIG. 16** was manufactured at room temperature. Using a high frequency sputtering apparatus and a metal mask, Al (100 nm)/$Co_2Fe_{0.5}Cr_{0.5}Al$ (5 nm)/Cu (6 nm)/$Co_2Fe_{0.5}Cr_{0.5}Al$ (5 nm)/NiFe (5 nm)/IrMn (10 nm)/Al (100 nm) were deposited in this order onto the thermally oxidized Si substrate, thereby the multi layer structure of a giant magnetoresistance effect device of the spin valve type was fabricated. The numerals in parentheses are respective film thicknesses.

[0160] Here, Al is a buffer layer **44**, $Co_2Fe_{0.5}Cr_{0.5}Al$ is a thin film **43** as a free layer, and Cu is a nonmagnetic metal layer **61** to realize giant magnetoresistance effect. The double layer structure of $Co_2Fe_{0.5}Cr_{0.5}Al$ (5 nm) and NiFe (5 nm) is the ferromagnetic layer **62** as a pin layer. IrMn is the antiferromagnetic layer **53**, and has a role to fix spins of the ferromagnetic layer **62** as a pin layer. Al layer on the top-most layer is the electrode layer **54**. Here, upon film forming, monoaxis anisotropy was introduced in film surface by applying magnetic field of 100 Oe. Said deposited multi layered film was microprocessed using the electron beam lithography and Ar ion milling apparatus, thereby the giant magnetoresistance effect device **75** of 0.5 μm×1 μm was fabricated.

[0161] The voltage was applied between the upper and lower electrodes **44** and **54** of said device, the electric current flew in the direction perpendicular to film surface, the external magnetic field was applied, and the magnetoresistance was measured at room temperature. Thereby, magnetoresistance of about 8% was attained. This value is 8 times as remarkably large as the magnetoresistance of the giant magnetoresistance effect device of CPP structure of the conventional spin valve type being lower than 1%. It turned out from this result that the reason why GMR of the giant magnetoresistance effect device of CPP structure of the present invention is remarkably large compared with that of the giant magnetoresistance effect device of CPP structure of the conventional spin valve type is attributed to the high spin polarizability of $Co_2Fe_{0.5}Cr_{0.5}Al$ thin film **43**.